

THE JACKSON ELECTRICAL
INSTRUMENT COMPANY

OPERATING INSTRUCTIONS
MODEL 106 R.F. SIGNAL GENERATOR

Your new Jackson Model 106 is a fine instrument. Into it have been built the highest quality and finest performance for which Jackson service-engineering is already famous. These instructions are furnished to assist you in getting the most value from your investment in this instrument. In your own interest, read this information thoroughly.

These instructions relate principally to the use of this instrument and matters pertaining to its design, calibration, etc. The most authoritative information on the actual work of aligning and adjusting a receiver is furnished by the manufacturer of that receiver. Correct procedure and the location of the various adjustments differ widely for different types and makes of receivers. The compilation of such data is not considered within the scope of these instructions. The service manuals should be consulted for the correct adjustment procedure for the particular set under test.

GENERAL DESCRIPTION

This instrument provides a radio frequency test signal modulated approximately 30 percent at 400 cycles or unmodulated as desired throughout its frequency range. The frequency range extends from 100 kilocycles to 216 megacycles directly calibrated on the dial scale. The signal is generated fundamentally in six ranges from 100 K.C. to 54 M.C. Harmonic frequencies are calibrated to extend the frequency range to 216 megacycles.

The R.F. output voltage is controllable by means of a variable control and a switch providing various output ratios. In addition to the normal R.F. output jack a high output connection makes available a higher than normal output voltage where required.

A 400 cycle audio voltage is available at the audio jack for audio frequency testing. This voltage is not adjustable.

The instrument is supplied with tubes installed and is ready to use. Two Type 6C4 tubes are used for oscillator and modulator. A selenium rectifier and isolating transformer form the power supply. Unless otherwise indicated, the instrument is for use on 110-120 volts, 50-60 cycle current only.

OPERATING CONTROLS

RANGE SELECTOR - This switch selects the six fundamental frequency ranges of the instrument as identified by the letters at the switch positions and on the dial scale. For example, range "A" provides test frequencies from 100 to 275 K.C. as calibrated on the "A" arc of the dial scale. Range "F" provides the fundamental range of 19 to 54 M.C., plus the calibrated 2nd and 4th harmonic ranges as calibrated on the dial scale.

SIGNAL - This switch has three positions. In the first position the instrument is turned off. At the second position marked "On Mod." a 400 cycle modu-

THE JACKSON ELECTRICAL
INSTRUMENT COMPANY

lated R.F. signal is generated by the instrument. With the switch set to the third position, marked "On Unmod." a continuous wave, unmodulated signal is generated by the instrument. Audio voltage is available from the Audio jack only when this switch is set to the "On Mod." position.

R.F. OUTPUT - This control in conjunction with the "Output Ratio" switch controls the intensity or signal strength of the R.F. output signal. It is continuously adjustable from zero to maximum.

OUTPUT RATIO - This control increases the output signal to the "R.F. Output" connection in direct ratio as marked.

FREQUENCY DIAL - The frequency control dial is directly calibrated in frequency for all ranges of the instrument. The upper half of the dial is calibrated in kilocycles from 100 to 7000 K.C. as provided by Ranges "A", "B", "C" and "D". The lower half of the dial is calibrated in megacycles from 6.5 to 216 M.C. which includes ranges "E" and "F" and the 2nd and 4th harmonic calibrations of range "F". For frequencies above 54 M.C. the range selector is set to range "F" and the "F2" and "F4" calibrated arcs on the dial scale used.

R.F. OUTPUT JACK - The coaxial output lead furnished with the instrument is connected to this jack to provide the signal for all normal alignment and test purposes. This connection provides the R.F. test signal whether either a modulated or unmodulated signal is desired.

HIGH R.F. OUTPUT JACK - When a higher than normal output signal is required, the coaxial output lead may be connected to this jack to obtain a larger signal output. The voltage to this jack is controlled by the "R.F. Output" control only. The "output ratio" switch does not control the output signal from this jack.

AUDIO JACK - With the "Signal" switch in the "On Mod." position, a 400 cycle audio voltage is available from this jack for audio test purposes. This jack provides an audio voltage only and cannot be used for R.F. or I.F. stage alignment. Approximately 35 volts is available when connected to a high impedance load.

OPERATION

For best accuracy the signal switch should be turned to one of the "On" positions and the instrument allowed to warm up a few minutes before use.

Set the "Signal" switch to the "On Mod." or "On Unmod." position depending upon whether a modulated or unmodulated signal is desired.

Connect the coaxial output lead furnished to the "R.F. Output" jack. Two leads are provided at the other end of this cable for connection to the receiver circuits. The shield lead is the ground lead and generally connects to the chassis ground of the receiver. The inside lead is the antenna or high output lead.

The receiver manufacturer's service instructions should be consulted to obtain

THE JACKSON ELECTRICAL
INSTRUMENT COMPANY

the recommended test points for connecting the signal to the receiver, the proper test frequencies and isolation network, if required, between the signal generator output and the receiver circuit connection point.

Set the frequency control dial to the desired frequency on the calibrated scale. Set the range selector to the corresponding letter on the dial scale arc being used.

The intensity of the output signal is controlled by the "R.F. Output" and "Output Ratio" controls. To prevent arc action and overloading of the receiver circuits, the lowest possible signal voltage should be used which will permit proper alignment. An output indicator should be connected to the audio portion of the receiver to indicate output during the adjustment. This may be either a direct reading output meter, a vacuum tube voltmeter or cathode ray oscilloscope.

In case a higher output voltage is desired than available from the "R.F. Output" jack connection should be made to the "High R.F. Output" jack. The output signal level is then controlled by the "R.F. Output" control only.

CAUTION - It is extremely important that the output leads should not be connected directly to receiver circuits having D.C. or A.C. voltages present which would be applied through the output leads back into the signal generator. In any case where voltage is on the circuit to which connections are made, a condenser must be used in series with the inside or high lead. High voltage applied to the signal generator may cause damage to the generator output circuit and to the receiver power supply.

AUDIO OUTPUT - An audio voltage of approximately 35 volts, 400 cycles is available at the "Audio" jack for audio signal testing. The signal switch must be set to the "On Mod." position and the output cable connected to the "Audio" jack. In testing audio circuits an isolating condenser must be connected in series with the high lead if connection is made to circuits containing D.C. voltages which may damage the instrument. The audio output voltage is not adjustable in value.

APPLICATION

The following information is furnished as a general guide and is not meant to supplant the receiver manufacturer's alignment and testing procedure which should in all possible cases be used. The use of this instrument in the alignment of F.M. and television receivers requires exact test procedure fitted to the design of the individual circuits. A generalized discussion of this use would be valueless and therefore is omitted from these application notes.

ALIGNMENT OF AMPLITUDE MODULATED RECEIVERS

Set the controls on the instrument for modulated signal output as previously explained.

Some form of output indicator should be used to indicate maximum output while making the receiver adjustments. This may be a rectifier type output meter

THE JACKSON ELECTRICAL
INSTRUMENT COMPANY

connected to the speaker voice coil or audio amplifier plate circuit. A vacuum tube voltmeter having A.C. ranges can be connected to the voice coil or any point in the audio circuit for indication. A D.C. Vacuum tube voltmeter or sensitive D.C. meter may be connected across the A.V.C. voltage for indication. A cathode ray oscilloscope may be connected to the audio portion of the receiver for indication of relative output.

I.F. ALIGNMENT. Set the signal generator to the I.F. frequency of the receiver. Connect the output leads from the R.F. Output jack to the grid of the converter stage using an isolating condenser if D.C. voltage is present on the grid. Adjust the I.F. trimmers for maximum output progressing from the last I.F. to the first I.F. transformer.

In some cases where the adjustments are badly out of line or special adjustments required, the generator is connected to the grid of the last I.F. tube and the last I.F. transformer aligned. The generator is then moved forward as each stage is aligned ending with the signal applied to the converter for the final adjustments.

The output signal should always be kept to a value low enough to prevent the receiver from overloading.

OSCILLATOR ALIGNMENT - The receiver oscillator frequency beats with the incoming signal to produce the intermediate frequency signal in the converter stage. Therefore it always operates at a frequency higher or lower than the signal frequency by an amount equal to the I.F. frequency of the receiver.

The receiver oscillator invariably has a padder for adjustment at the high frequency end of the band. Some circuits have a series trimmer condenser or coil inductance trimmer for adjustment at the low frequency end of the band.

Connect the signal generator output to the antenna input terminals of the receiver. Set the frequency of both the signal generator and the receiver dial to the recommended test frequency at the high frequency end of the band. Adjust the receiver oscillator padder for maximum output. Next set both the signal generator and the receiver dial to the recommended low frequency test point and adjust the series padder or iron core adjustment for maximum output. In case either adjustment were badly out of alignment it will be necessary to repeat the adjustments several times for the best possible tracking of the receiver dial.

RF AND CONVERTER STAGE ALIGNMENT - Set the signal generator to the recommended test point at the high frequency end of the band and connect to the receiver antenna connections. Tune the receiver dial for maximum output, and then adjust the R.F. and converter stage trimmers for maximum output. A few receivers have an iron core inductance trimmer which is adjusted for maximum output at the low frequency end of the band.

SIGNAL TRACING - In one method of signal tracing a signal is applied to the antenna connections of the receiver and the progress of the signal is checked from the antenna to the speaker with a signal tracer instrument. This normally consists of an R.F. detector for indicating the signal voltage in the R.F. and

THE JACKSON ELECTRICAL
INSTRUMENT COMPANY

I.F. sections and some form of audio voltmeter for indication of the audio signal throughout the audio section. This requires a separate instrument to indicate the presence of the signal throughout the receiver.

The Model 106 may be used to trace the signal throughout the receiver in the reverse manner in which a separate signal tracer is used. This is done by injecting a signal, either audio frequency or radio frequency, as required into the receiver circuit, starting with the last audio stage and progressing toward the antenna connections of the receiver.

Audio voltage is obtained from the Audio Jack on the Model 106 for checking the audio section of the receiver. This voltage is applied to the grids of the audio stages to check their operation. The ground lead must be connected to chassis ground and it is good practice to insert a bypass condenser in series with the high lead to isolate any D.C. voltage that may be present. A .1 to .5 MFD condenser would be a suitable value.

R.F. AND I.F. STAGES - The R.F. and I.F. portions of the receiver are checked by using the R.F. signal obtained from the R.F. Output Jacks. Connection is made to the grid of the last I.F. tube to check that stage and then moved forward to the grid of each preceding stage ending with connection to the antenna leads. The ground lead must be connected to chassis ground and a small mica condenser connected in series with the high lead to isolate any D.C. voltage present in the circuit.

The signal generator is set to the I.F. frequency when connection is made to the I.F. Circuit. At the converter grid a test signal at the I.F. frequency and the signal frequency to which the set is tuned should produce an output signal. Connection to the R.F. grid or antenna is made with the signal generator set to the signal frequency to which the set is tuned.

The circuit to which the signal generator is connected will be detuned somewhat by the capacity of the connecting leads. Also when connection is made to a single stage such as the last I.F. stage, the tuning of the circuit will appear quite broad. It is recommended that the High R.F. Output jack from the signal generator be used in tracing the signal through one or two stages where a large signal is required.

The R.F. Signal should be modulated to provide an audible signal in the speaker or reading on an output meter.

RECEIVER OSCILLATOR TESTS - A defect is indicated in the receiver local oscillator when the I.F. frequency is amplified but the signal frequency to which the set is tuned is not, with the signal introduced into the converter grid. The signal from the Model 106 may be substituted for the local oscillator in the receiver in case it is suspected of being faulty.

Connect the signal generator output leads to the injector grid or point on the converter stage where the local oscillator signal is injected. Set the signal generator to provide an unmodulated signal. Tune the receiver to a strong local station. Now adjust the signal generator frequency to the receiver dial frequency plus or minus the I.F. frequency of the receiver.

THE JACKSON ELECTRICAL
INSTRUMENT COMPANY

Amplitude modulated receiver practice in the broadcast and low frequency bands normally places the local oscillator at higher than the signal frequency. For example, with the receiver dial set to 800 K.C. and the I.F. frequency 465 K.C., the local oscillator frequency would be 800 plus 465 or 1265 K.C. The signal generator would be set to this frequency.

In the high frequency bands in either F.M. or A.M. receivers, the local oscillator may operate at a frequency higher or lower than the received signal. For example, with the receiver dial set to 90 megacycles and the I.F. frequency 10.7 M.C., the local oscillator would operate on either 79.3 M.C. or 100.7 M.C. With the signal generator set to either of these frequencies the 90 M.C. signal should be heard.

If the substitute signal makes the set function it is apparent that the receiver local oscillator is defective.

USE AS MARKER OSCILLATOR - In the testing of television receivers a sweep frequency signal generator is used to produce a visual response curve of the wide band tuned circuits. Marker oscillators are used to locate precise frequency points on the response curve. The Model 106 may be used for this purpose by connecting its output to the same point in the circuit to which the sweep generator's output is connected. The voltage injected by the Model 106 will produce a marker pip on the response curve at its operating frequency. The voltage output should be adjusted to produce a small pip which will not distort the overall response curve. The exact frequency of the various points on the response curve can be obtained from the frequency calibration of the marker oscillator.

MISCELLANEOUS NOTES ON THE USE OF THE MODEL 106

Those receivers having a loop antenna used as the tuned circuit of the input stage would be detuned if the signal generator were connected across the loop circuit. In this case a temporary loop consisting of several turns of insulated wire six or eight inches in diameter may be connected to the R.F. Output leads of the signal generator. This loop is loosely coupled to the receiver loop antenna to provide the input signal.

When separate antenna terminal connections are provided on receivers having a loop antenna, the signal generator may be connected to the antenna terminals in the regular manner.

A.C. - D.C. RECEIVERS - This type receiver has the chassis at common ground potential or a common negative circuit isolated from the chassis. The ground lead from the signal generator must be connected to the common negative circuit in the latter case.

Another precaution is necessary in servicing A.C. - D.C. receivers. One side of the power line is invariably grounded through the power company distribution system. This places one side of the receiver high voltage system at actual earth ground potential. If the line plug of the receiver is inserted in such a direction that the ungrounded side of the power line is connected to the common negative circuit, a line power short will occur if the chassis or common negative circuit is earth grounded.

THE JACKSON ELECTRICAL
INSTRUMENT COMPANY

This condition can occur if the signal generator case is at earth ground potential and connection is made to the receiver chassis. To prevent shock hazard or damage to equipment, the receiver plug should be inserted in the line receptacle so the common negative circuit is the earth ground side of the power line.

Using the signal generator under conditions where the receiver chassis or common negative circuit is above ground potential will probably cause A.C. hum to be introduced into the test signal.

By the use of a 1 to 1 ratio isolating transformer between the power line and the receiver, A.C. - D.C. sets can be tested with the same freedom as any transformer type receiver.

TECHNICAL SECTION

LINE INPUT CIRCUIT - Each side of the line input circuit of the instrument is bypassed to the case as part of the R.F. line filter. This places the instrument case at an electrostatic potential equal to one-half the line input voltage.

Since one side of the input line is usually at earth ground potential, a static voltage will exist between the instrument case and earth ground. If this voltage proves objectionable in the application of the instrument, the case may be connected to earth ground to eliminate the static voltage.

R.F. ATTENUATION - The case radiation is negligible below approximately 30 megacycles with normal receivers. Above this frequency the case radiation of the signal generator increases and direct pickup of the signal may be obtained. The amount of direct pickup will depend upon the shielding of the receiver circuits, the antenna effect of the connecting leads and the impedance above ground of both the signal generator case and the receiver chassis.

In the high frequency ranges a lower signal value may be required than the minimum signal produced by the Model 106. In these cases it is recommended that the signal generator be set to one-half the desired frequency and the second harmonic of the signal used for test purposes.

ACCURACY STATEMENT - This instrument has been calibrated to an accuracy of 1/2 of 1 percent on all frequency ranges.

MAINTENANCE - This instrument has been carefully calibrated at the factory. The highest quality materials and workmanship have been used in its construction. Under normal operating conditions the instrument should maintain its calibration accuracy for long periods of time. The following service notes, illustration and circuit diagram give the necessary information for any normal service of the equipment. Our Engineering Department will be glad to furnish any additional information that may be required.

REMOVAL FROM CASE - Remove the eight screws from the front panel flanges and lift the front panel from the instrument case.

THE JACKSON ELECTRICAL
INSTRUMENT COMPANY

RECALIBRATION - To calibrate the instrument the signal from the Model 106 is compared with a standard frequency signal using a receiver for detection of the beat between the two signals. The standard signal must be accurate and provide the correct frequencies for the various calibration points.

VARIABLE CONDENSER - The accuracy of the calibration throughout any range of the instrument depends upon the capacity curve of the variable condenser. This condenser has been carefully adjusted at the factory. If recalibration is necessary do not disturb this condenser. It will be found that the overall accuracy can be brought well within limits by adjustment of the capacity and inductance trimmers for each coil range.

CALIBRATION OF THE VARIABLE R.F. OSCILLATOR - Remove the shield cover from the rear of the oscillator assembly in the center of the chassis. This gives access to the six coils of the oscillator unit. Do not remove the complete shield as this would affect the calibrations when it is replaced.

Each coil has a capacity trimmer for adjustment at the high frequency end of its range. Each coil except range "F" has an iron core inductance trimmer for adjustment at the low frequency end of its range. Range "F" coil is an open wire inductor. Its inductance is increased by squeezing its turns closer together or decreased by spreading them apart.

TO CALIBRATE ANY RANGE -

1. Set the dial to a point near the high frequency end of the range.
2. Adjust the trimmer condenser for that range to zero beat with the standard calibrating signal.
3. Set the dial to a point at the low frequency end of the range.
4. Adjust the inductance of the coil to zero beat with the standard calibrating signal

Ordinarily it will only be necessary to adjust the trimmer condenser at the high frequency end of the range to correct the calibration. If it is found necessary to adjust the inductance, Steps 1 and 2 should be repeated.

See Figure 1 which shows location of the various coils and adjustments.

